Radiative transfer calculation for various planetary atmospheres

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A lot of exoplanets have been discovered. One of the interesting questions on those exoplanets is its surface environment and circulation structure. A first step to understand surface environments is an investigation of radiative budget of the planets. But, calculation of radiative transfer of various planets have several difficulties. One of those is huge computational cost, and another is uncertainty of radiative properties of atmospheres which is very different from Earth's atmosphere. In this study, we are developing a radiation model which can be applied to various planetary atmospheres.
In developing a radiation model for atmospheric circulation models, a line-by-line model is developed, first. Then, we develop a radiation model based on correlated k-distribution method, which require much fewer computational cost. The line-by-line calculation is performed with Voigt line profile calculated with Humlicek (1982) method. Gas absorption line parameters are obtained from HITRAN2012 (Rothman et al., 2013). But, for calculation for high temperature condition, absorption line parameters by HITEMP2010 (Rothman et al., 2010) are used. Continuum absorption of water vapor is considered by the use of the MT_CKD model (Mlawer et al., 2012). For calculation for thick carbon dioxide atmosphere, such as Venus atmosphere, collision induced absorption from several sources are used for carbon dioxide.
In order to validate the model, radiative fluxes and tendencies are calculated for the Earth, Venus, present Mars, and early Mars. In the presentation, comparison of radiative fluxes and tendencies calculated by our model with those by observation and/or by other models will be presented.

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